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Mitigation Actions in Brazil

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Country Study

Mitigation Actions in Brazil

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ABSTRACT

This paper presents and discusses the main findings of a study focusing on climate change Mitigation Actions (MAs) in Brazil.

The Brazilian government presented to the 15th Conference of the Parties of the Climate Change Convention held in Copenhagen in 2009 (UNFCCC COP15) voluntary mitigation goals: a reduction of between 36.1% and 38.9% of the country´s GHG emissions projected to 2020. If Brazil meets its voluntary goals its GHG emissions in 2020 will be 6%–10% lower than in 2005.

The main research question addressed in this study is: will Brazil be able to meet its pledge? It discusses how MAs are approached, conceptualized and implemented in Brazil. It describes how the country identifies MAs and the contextual framework used to define MAs. It also maps the initiatives underway in the country, and analyses the issues faced for its successful implementation, as well as for future approaches to MAs.

The main conclusion is that Brazil seems in a good position to meet its voluntary mitigation goals up to 2020, as avoided deforestation will take up the bulk of the emissions reduction. After 2020, Brazil will be faced with a new challenge of economic development with low GHG energy-related emissions.

Keywords

Mitigation action, implementation, financing, NAMA, MRV, carbon tax, mitigation scenarios; development pathways; land use, land use change and forestry; energy policy.

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1. INTRODUCTION

This paper presents and discusses the main findings of a study developed for the MAPS programme[i], focusing on climate change mitigation actions (MAs) in Brazil.

The Brazilian government presented to the 15th Conference of the Parties of the Climate Change Convention held in Copenhagen (UNFCCC COP15), voluntary mitigation goals: a reduction of between 36.1% and 38.9% of the country´s GHG emissions projected to 2020. This move was followed by other emerging economies, notably by China, India and South Africa. It is important to note that if Brazil meets its voluntary goals its GHG emissions in 2020 will be 6%–10% lower than in 2005. This reduction in absolute terms is far more ambitious than the voluntary goals pledged by other emerging economies up to 2020. China and India have goals of reducing the GHG emissions intensity of GDP, but the high economic growth rates projected would imply a significant increase of absolute GHG emissions. South Africa's pledge is the reduction of GHG emissions compared to a baseline growth, but still implying an absolute increase of GHG emissions in 2020 (see Jiang et al, 2009; MoEF, 2010; SBT, 2007).

The main research question addressed in this study is: will Brazil be able to meet its pledge? It discusses how MAs are approached, conceptualised and implemented in Brazil. It describes how the country identifies MAs and the contextual framework used to define MAs. It also maps the initiatives underway in the country, and analyses the issues faced for its successful implementation, as well as for future approaches to MAs.

The first section provides an overview of Brazilian GHG emissions from 1990 to 2005, showing the main GHG emission sources. Section 2 presents the Brazilian voluntary GHG emission mitigation goals first introduced in Copenhagen (COP15) and confirmed in Cancún (COP16). The current status of implementation of MAs in the country is described in Section 3. Finally, specific issues related to the implementation of Brazilian MAs are discussed in Section 4, for each of the four major GHG emission sources (land use change, agriculture, forestry and animal husbandry; energy; and others), including:

- development of MAs (from the idea to concept note, business plan, and successful implementation);
- planning, policy and regulatory context (both of individual MAs and broader plans or strategies);
- institutional capacity to take MAs to implementation;
- technical capacity to design and domestically monitor, report and verify (MRV) MAs;
- financing; ownership (who initiated and 'owns' the MA); and
- the technical capacity to design MAs.

The final concluding remarks summarise the main results of this research study.

2. BRAZIL´S GHG EMISSION INVENTORIES

Brazil's first and second national communications to the UNFCC provide GHG emission inventories for the period from 1990 to 2005 are presented in the table below.

TABLE 1: GHG EMISSIONS IN BRAZIL, 1990–2005[ii]

GHG emissions (M t CO_2eq / year)	*1990*	*1994*	*2000*	*2005*	*Var % 90/05*	*Part % 1990*	*Part % 2005*
Agriculture/husbandry	347	378	401	487	41%	25.4%	22.1%
Energy	215	256	328	362	68%	15.8%	16.4%
Industrial processes	27	29	35	37	39%	2.0%	1.7%
Wastes	28	32	41	49	77%	2.0%	2.2%
Land Use Change	746	790	1247	1268	70%	54.8%	57.5%
TOTAL	**1 362**	**1 485**	**2 052**	**2 203**	**62%**	**100 %**	**100 %**

The main source of greenhouse gas (GHG) emissions in Brazil is deforestation caused by the expansion of agricultural frontiers, mainly in the Amazon region. Good estimates of deforested land surface are available from satellite image recovery. However, the corresponding CO_2 emissions are very hard to quantify due to lack of reliable data concerning the biomass densities of the different kinds of forests and savannahs affected.

Agriculture and husbandry are key sectors of Brazilian economy, which explains why they rank second as main GHG emission sources. Because of the country's vast agricultural and grazing lands, it is one of the largest agricultural producers in the world, and ranks second in soybean production, with 18% of the global total. It also has the second largest bovine herd in the world, with 12% of the global total. In this sector, CH_4 emissions are dominant, as a result of the phenomenon of enteric fermentation of ruminant herbivores, which include the huge cattle herd.

The energy sector comes only third as GHG emitter, due to the role played by hydropower and renewable biomass (ethanol from sugar cane, wood and charcoal from forest plantations, and biodiesel from vegetable oils cultivation) allowing for a 45% share of renewables in the country´s total energy supply.

3. BRAZIL´S VOLUNTARY GHG EMISSION MITIGATION GOALS

Brazil has already been making substantial efforts to limit its GHG emissions, including the curbing of Amazon deforestation and the important investment in renewables. For the future, the National Climate Change Policy Law approved by the Congress and sanctioned by the President on 29 December 2009 (Federal Law no 12187) included the voluntary goals to limit the country's GHG emissions presented the month before at COP15 in Copenhagen. The voluntary goals were established as a reduction of between 36.1% and 38.9% of the country´s GHG emissions projected to 2020. Preliminary estimates of a business as usual (BAU) scenario and of a mitigation scenario of the country´s GHG emissions in 2020 were made by several government bodies in the run-up to Copenhagen, discussed in the Brazilian Forum on Climate Change (FBMC) and constituted the basis of this pledge. These preliminary estimates are presented in Table 2.

TABLE 2: PRELIMINARY ESTIMATES OF BRAZIL'S GHG EMISSIONS AND MITIGATION ACTIONS IN 2020[iii]

Emissions / MA (Mt CO_2eq / year)	*2005 inventory data*	*2020 BAU scenario*	*2020 Mitigation scenario*	*Reduction in 2020 (M t CO_2eq)*	*Reduction / BAU total in 2020 (%)*
Land use change	1 268	1 084	415	669	24.7%
Agriculture / husbandry	487	627	461 – 494	133–166	4.9–6.1%
Energy	362	901	694 – 735	166–207	6.1–7.7%
• Energy efficiency				12–15	0.4–0.6%
• Biofuels increase				48–60	1.8–2.2%
• Hydropower increase				79–99	2.9–3.7%
• Small hydro, biomass, wind				26–33	1.0–1.2%
Others	86	92	82 – 84	8–10	0.3–0.4%
TOTAL	**2 203**	**2 703**	**1 652 – 1 728**	**975–1 052**	**36.1–38.9%**

Note: Mt CO_2eq = million tons of CO_2eq

The final figures had to wait the completion of the Second National Communication, in 2010. Therefore, it was only on 9 December 2010, during COP16 in Cancún, that Brazilian government published a decree (Federal Decree no 7390) regulating the articles of Law no 12187 regarding the final figures of the voluntary goals for the amount of avoided GHG emissions in 2020.

TABLE 3: FINAL FIGURES OF BRAZIL'S GHG EMISSIONS AND MITIGATION ACTIONS IN 2020[iv]

Emissions (Mt CO_2eq / year)	*1990 inventory data*	*2005 inventory data*	*Variation 1990–2005 (%)*	*2020 BAU scenario*	*Variation 2005–2020 BAU (%)*	*MAs / avoided emissions in 2020*
Land use change	746	1 268	70%	1 404	11%	
Amazon				948		
Savannahs				323		
Others				133		
Agriculture /Husbandry	347	487	41%	730	50%	
Energy	215	362	68%	868	140%	234
Industrial processes & wastes	55	86	39%	234	172%	
Total	**1 362**	**2 203**	**62%**	**3 236**	**47%**	**1 168–1 259**

Unlike the preliminary estimates made in 2009, the decree does not establish a full mitigation scenario with voluntary goals for each main source of emissions. The only exception is the energy sector, because the government considers the current 10-year energy plan as a mitigation scenario, as it includes a number of efforts to increase the role of renewables, nuclear and energy efficiency in the energy policy.

The main contribution to curb the country's GHG emissions will come from the efforts to reduce deforestation in the Amazon, following the successful record of recent years. The goal set for the agriculture sector is very ambitious, considering the recent growth of the country's grains and meat exports. However, economically feasible mitigation alternatives already exist and have a great potential: recovery of degraded pasture land, agroforestry schemes, more intensive cattle-raising activities (given the current low average ratio of 0.5 heads per hectare), biologic nitrogen fixation and low tillage techniques, which covers more than 20 million hectares in the country and is rapidly spreading.

In the case of the emissions of industrial processes and waste disposal, grouped under other sectors due to its minor contribution to the total, the BAU scenario already shows a low growth trend, and the voluntary commitments aim to keep roughly constant GHG emissions in these sectors. Again, there are feasible mitigation options in these sectors, such as the capture, burning and/or energy use of biogas in sanitary landfills that make it possible to achieve this objective.

The case of the energy sector deserves special attention. The emissions due to the use of fossil energy have been increasing significantly in the country in the form of oil products, natural gas and coal. These fuels play a basic role in the modern part of the Brazilian economy, such as industry and transport, as well as agribusiness and the residential, commercial and service sectors. Its share in power generation has also been increasing, starting from a low level, to complement the use of the huge Brazilian hydropower potential, which is by far the dominant energy source for generating electricity in the country. Thus, the emission of GHGs due to the use of energy, especially the CO_2 resulting from burning fossil fuels, showed a high growth rate between 1990 and 2005, reaching in 2005 a level 68% higher than in 1990. Indeed, economic growth, the rising urbanisation and the dominance of road transportation in the country are the driving forces to increase fossil energy consumption and associated CO_2 emissions.

Thus, unlike in other sectors, the BAU scenario projected by the government shows a significant increase in emissions due to the consumption of fossil fuels by 2020, fostered by an average GDP growth projected at 5% pa: a rise of 140% compared to 2005, that is, 2.4 times the level of 2005 emissions in this sector.

As far as mitigation is concerned, the levels of hydropower generation, energy efficiency and alcohol production were those included in the 10-Year Energy Expansion Plan (PDE) for 2020 (EPE, 2010). Other mitigation actions included were the production and use of biodiesel in a 5% blend with diesel oil for 2020 (B5) and the increase in power generation from other renewable sources: small hydropower plants, biomass (especially sugarcane bagasse) and wind energy. Even so, GHG emissions due to the use of fossil fuels in the country will be 75% higher in the mitigation scenario compared to 2005 emissions. The achievement of the mitigation scenario goals will require the implementation of public policy tools capable of stimulating the substitution of renewable energy sources for the use of fossil fuels. This need will be even more acute in the future to drive the Brazilian economy towards a low carbon path, as fossil fuels will become the most important source of GHG emissions, as elsewhere in the industrial world.

4. THE IMPLEMENTATION OF BRAZIL´S MITIGATION ACTIONS

4.1 Legal instrument: Federal Decree nº 7390, 2010

The Decree no 7390 is a step towards detailing the voluntary mitigation goals established by the government in Law no 12187, but still leaves much flexibility as to the actual way of achieving these goals. Only the energy sector has already established the amount of avoided GHG emissions in 2020, according to the PDE. For the other sectors, the decree refers to four other sectoral mitigation plans already elaborated:

- Plan of Action for Prevention and Control of Deforestation in the Amazon–PPCDAm.
- Plan of Action for Prevention and Control of Deforestation and Fires in the Savannahs–PPCerrado.
- Plan for Consolidation of a Low Carbon Emission Economy in Agriculture.
- Plan of Emission Reduction in the Steel sector.

The decree lists a number of mitigation actions included in the available sectoral plans:

(i) A reduction of 80% of the annual deforestation surface in the Amazon, compared to the historical average in the period 1996-2005; this figure is of 1.95 M ha/year, and together with the average biomass density of 132 t C/ha (484 t CO_2/ha) it was used to project the BAU emission level of 948 M t CO_2/y in 2020; assuming a constant biomass density, this decrease in the Amazon deforestation rate would allow for avoided emissions of 758 M t CO_2/y in 2020.

(ii) A reduction of 40% of the annual deforestation surface in the savannahs, compared to the historical average in the period 1999-2008; this figure is of 1.57 M ha/year, and together with the average biomass density of 56 t C/ha (206 t CO_2/ha) it was used to project the BAU emission level of 323 M t CO_2/y in 2020; assuming a constant biomass density, this decrease in the savannahs deforestation rate would allow for avoided emissions of 129 M t CO_2/y in 2020.

(iii) An increase of renewable power generation through large hydropower, wind, small hydro and bioenergy projects, and of biofuels (ethanol from sugarcane and biodiesel from vegetable oils), and energy efficiency improvements as projected in the PDE; the amount of avoided emissions in 2020 was estimated at 234 M t CO_2/y considering that all this additional renewable energy generation and energy saved would come from fossil fuels.

(iv) Recovery of 15 million hectares of degraded pasture land.

(v) Increase of four million hectares of the land covered by agroforestry schemes, coupled with more intensive cattle-raising activities (integrated agriculture / husbandry / forestry activities).

(vi) An increase of eight million hectares in the planted area under low tillage techniques.

(vii) An increase of 5.5 million hectares of areas cultivated with biologic nitrogen fixation techniques replacing the use of nitrogenous fertilisers.

(viii) An increase of three million hectares of forest plantations.

(ix) An increase of 4.4 million cubic metres in the use of technologies for proper treatment of animal wastes.

(x) An increase in steel manufacturing using charcoal from planted forests and improvements to the efficiency of charcoal kilns.

4.2 Additional sectoral plans to achieve the mitigation actions

The Decree also establishes a requirement for the elaboration of additional sectoral mitigation plans for those sectors included in the 2009 law:

- public urban transportation;
- interstate transport of cargo and passengers;
- transformation industry;
- durable consumer goods industry;
- chemical industry;
- pulp and paper industry;
- mining;
- civil construction; and
- the health sector.

All these sectoral mitigation plans must include:

- emission reductions in 2020, with milestones for every three-year period;
- mitigation actions to be implemented;
- establishment of indicators for monitoring of performance and assessment of effectiveness;
- proposal of tools and incentives to be adopted in the implementation of the plans;
- sectoral studies of cost estimates and implications for competitiveness.

The Decree requires an inclusive public consultation process for the discussion of the sectoral mitigation plans, and allows for the possibility of using the sectoral mitigation goals in the establishment of the Domestic Carbon Market authorised by the 2009 law. The institutional responsibility for coordinating the actions of the sectoral mitigation plans, under the umbrella of the National Climate Change Plan, remains with the Interministerial Commission on Global Climate Change (CIMGC), while the Brazilian Climate Change Forum (FBMC) is responsible for the follow-up of the actions implementation. A working group coordinated by the Ministry of Science and Technology (MCT) will be responsible for publishing an annual estimate of the country´s GHG emissions.

The Decree also requires that all federal government multi-year plans and annual budget laws include the provision for the mitigation programmes and actions included in the decree.

4.3 Financial incentive mechanisms[v]

Other tools to implement the sectoral mitigation plans include the Clean Development Mechanism (CDM) projects and 'nationally appropriate mitigation actions' (NAMAs), according to the decree, besides the National Climate Change Fund created in 2009 by Federal Law nº 12114.

The sale of the certified emission reductions (CERs) issued under the CDM is viewed as an important financing instrument to reach voluntary goals set by the Brazilian government. Most of the key objectives can benefit from carbon revenues; these include cogeneration and other renewable energy solutions such as hydropower, afforestation and reforestation, energy efficiency, and fuel-switching programs. Most of the 163 CDM projects in Brazil are renewable energy projects,

which focus on sugarcane bagasse cogeneration. Bagasse cogeneration represents 48% of total projects, followed by biogas (17% of all projects), and solid waste management (30%). Most projects were developed in the states of São Paulo (22%), Minas Gerais (14%) and Rio Grande do Sul (10%). CDM cogeneration projects account up to 2010 for a total of 1,126 MW installed capacity, while small hydropower plants account for 985 MW and wind energy 676 MW. Few reforestation projects are implemented as methodologies were developed slowly and market demand is reduced due to the temporary nature of this asset.

Brazil has existing sources of funding for energy efficiency and renewable energy through government-mandated levies; these are directed towards funds such as the Fuel Consumption Account (CCC) for power off grid generation in the Amazon region, Energy Development Account (CDE), and Global Reversion Reserve (RGR). According to the National Agency for Electric Energy (ANEEL), CDE collections for 2009 are estimated at € 1.12 billion. Collections for the RGR Fund had reached nearly € 3 billion at the end of fiscal year 2008. Managed by Eletrobrás, RGR is a main source of funding for energy efficiency programs under the Electricity Conservation Program (Procel). With regard to the CCC, collected levies totalled approximately €0.5 billion in 2008. Not all of the funds collected are used for renewable energy or energy efficiency projects, but they are significant in size.

Other funds that receive similarly mandated levies but are not limited to energy-related activities include the Constitutional Financing Fund of the Northern, Northeastern, and Center-West Regions (FNO, FNE, and FCO, respectively). These funds receive 3% of overall tax collections, which are then used to finance activities in the respective regions; they are managed by banks such as the Banco da Amazonia, Banco do Nordeste, and Banco do Brasil. In 2009, their budgets were €1.10 billion (FNO), €3.00 billion (FNE), and €1.15 billion (FCO). Financing programmes include support for activities such as decreased deforestation and increased livestock productivity.

5. SPECIFIC ISSUES RELATED TO THE IMPLEMENTATION OF BRAZILIAN MITIGATION ACTIONS

The successful achievement of the country's voluntary GHG emission mitigation goals will depend upon the capacity to handle a number of issues that arise in the implementation of MAs, including:

- development of MAs (from the idea to concept note, business plan, and successful implementation);
- planning, policy and regulatory context (both of individual MAs and broader plans or strategies);
- institutional capacity to take MAs to implementation;
- technical capacity to design and domestically MRV MAs;
- financing;
- ownership (who initiated and 'owns' the MA); and
- technical capacity to design MAs.

These issues will be briefly discussed here for the MAs in each of the main sources of GHG emissions in the country: land use change; agriculture, forestry and animal husbandry; energy; and others (including industrial processes and wastes).

5.1 Land use change

This is the most important source of GHG emissions in the country, and successful efforts to reduce deforestation particularly in the Amazon and 'cerrado' regions will be crucial to the achievement of Brazilian voluntary goals, as shown in sections 2 and 3. Two Plans, one for each biome, gather the MAs defined to meet the voluntary goals related to this source:

- Plan of Action for Prevention and Control of Deforestation in the Amazon–PPCDAm.
- Plan of Action for Prevention and Control of Deforestation and Fires in the Savannahs–PPCerrado.

The MAs developed include:

- A reduction of 80% of the annual deforestation surface in the Amazon, compared to the historical average in the period 1996-2005; this figure is of 1.95 M ha/year, and together with the average biomass density of 132 t C/ha (484 t CO_2/ha) it was used to project the BAU emission level of 948 M t CO_2/y in 2020; assuming a constant biomass density, this decrease in the Amazon deforestation rate would allow for avoided emissions of 758 M t CO_2/y in 2020.
- A reduction of 40% of the annual deforestation surface in the savannahs, compared to the historical average in the period 1999-2008; this figure is of 1.57 M ha/year, and together with the average biomass density of 56 t C/ha (206 t CO_2/ha) it was used to project the BAU emission level of 323 M t CO_2/y in 2020; assuming a constant biomass density, this decrease in the savannahs deforestation rate would allow for avoided emissions of 129 M t CO_2/y in 2020.

The Ministry of Environment (MMA) takes the lead in the definition and implementation of these MAs, coordinating the action of other ministries, such as MCT, the Ministry of Defence and the Ministry of Justice, and of subnational governments (states and municipalities). The key target is the enforcement of laws and regulations that prevent illegal deforestation of conservation units and private properties. The Brazilian Forest Code is the most important piece of

legislation in this regard, as it rules that only 20% of the original forest coverage of private properties can be cleared in the Amazon region.

The operational bodies within MMA (The Forest Service and the National Environmental Agency–IBAMA) have the technical capacity to design the modalities of implementing these MAs. However, the institutional capacity to actually enforce the laws and regulations, particularly in the Amazon region, is insufficient to cope with the powerful economic driving forces of deforestation (the dynamics of expansion of the agricultural frontier, led by logging, cattle-raising and soybean plantations). A strong political will is required to keep all the governmental institutions mobilized in operation to constantly verify the respect of the law. The recent record has shown the viability of a successful performance in this field, as deforestation in the Amazon was limited to 1.2 M ha in 2007 and 0.7 M ha in 2008, down from an average of 1.95 M ha/year in the period 1996-2005. However, this trend was reversed last year, with an increase in the deforestation in the Amazon region. This was partly due to the prospects of approval by the Congress of a new version of the Forest Code, relaxing some constraints on the removal of forest cover in private properties. Right now a ferocious political debate around the Forest Code reform is ongoing, and its outcome is still uncertain (the President has to approve the final version of the amendment made by the Congress).

Due to sovereignty concerns, all the financing of these MAs will come from the national budgets at the federal, state and municipal levels.

The main MRV issue related to these two Plans is the estimate of the biomass density of the forest cover in the deforested surface, as satellite imagery provides a reasonable guess of the affected area (although some small-scale deforested areas may be difficult to spot). As a forest inventory is not available for the whole Amazon, a special methodology was developed for calculating the GHG emissions inventory of the country, from 1990 to 2005, in Brazil's Second National Communication to the UNFCCC (2010), improving the work done in the First National Communication (2004). This methodology was developed by the National Spatial Research Institute–INPE, belonging to MCT. An independent monitoring of the deforestation in the Amazon is also carried out by a NGO, the Amazon Research Institute–IPAM. Therefore, MRV of these MAs will have the same credibility as Brazilian National Communications to the UNFCCC.

Besides these two Plans, it is worth mentioning a different kind of effort that might turn out to develop into MAs in the medium- or long-term future: the Amazon Fund, established in 2009. Funding in this case comes from international cooperation, through a pioneer US$1 billion grant from the Norwegian government, and will also benefit from other grants from international donors (the German government and several NGOs have announced their support for the fund). However, all the decisions concerning the allocation of funds are solely the responsibility of the National Economic and Social Development Bank (BNDES), a key condition that had to be met in the setting up of the Fund to dismiss any sovereignty concern. In its first year of operation the Fund has already received 45 proposals and has started supporting five projects implemented by NGOs in the Brazilian Amazon. BNDES is preparing to extend the coverage of the Fund to support projects in neighbouring countries in the Amazon region. Most of the projects are initiatives from NGOs related to innovative approaches to supply economic incentives to keeping the forest cover in the Amazon, including the reduction of emissions from deforestation and forest degradation (REDD+). They cannot be labelled as MAs today, as GHG avoided emissions are not the main deliverable of these projects, but these experiments might well develop into MAs in the future.

The contrast between the Amazon and 'Cerrado' Plans, on one hand, and the Amazon Fund, on the other, shows the borderline drawn by the Brazilian government in the delicate issue of sovereignty and international support to MAs. The enforcement of laws and regulations remains the sole responsibility of the government, without any financial support from

abroad. However, it is acknowledged that the driving forces of deforestation are very powerful and demand the establishment of economic incentives to keep the forest cover in the long term, going far beyond the sole command-and control policies and measures. International cooperation towards this end is most welcome.

5.2 Agriculture, forestry and animal husbandry

This is currently the second most important source of GHG emissions in the country. The Plan for Consolidation of a Low Carbon Emission Economy in Agriculture gathers the MAs defined to meet the voluntary goals related to this source:

- recovery of 15 million hectares of degraded pasture land;
- increase of four million hectares in the land covered by agroforestry schemes, coupled with more intensive cattle-raising activities (integrated agriculture / husbandry / forestry activities);
- increase of eight million hectares of the planted area under low tillage techniques;
- increase of 5.5 million hectares of areas cultivated with biologic nitrogen fixation techniques replacing the use of nitrogenous fertilisers;
- increase of three million hectares of forest plantations;
- increase of 4.4 million cubic metres in the use of technologies for proper treatment of animal wastes.

The Ministry of Agriculture takes the lead in the definition and implementation of these MAs, coordinating the action of other ministries, such the Ministry of Planning, Budget and Management and the Ministry of Economy, and of subnational governments (states and municipalities). The key policy tool is the establishment of eligibility requirements for farmers to get credit from governmental development banks, and of economic incentives to access softer loans from these public bodies (mainly from the Banco do Brasil but also from BNDES and others). This is already current practice of these players (e.g. farming requirements from zoning plans must be met to access public funds) that may be extended to integrate MAs.

The financing of these MAs will come from the usual sources of funding to national development banks, including the financial market, besides national budgets at the federal, state and municipal levels. It is thus conceivable that in the future these MAs may become candidates for financial support to NAMAS to be provided through UNFCCC mechanisms. As the targets can be considered very ambitious, this financial support could be valuable to improve the institutional capacity in the country to meet them. The Brazilian development banks that are the primary source of credit to agricultural, forestry, and animal husbandry activities would be potential owners of the MAs, under the political coordination of the Ministry of Agriculture.

The operational body dealing with research and development within MAs, the Brazilian Agriculture Research Enterprise (EMBRAPA), a network of research centres, has the technical capacity to design the modalities of implementing these MAs and also to deal with the MRV-related issues.

5.3 Energy

The emissions due to the use of fossil energy have been increasing significantly in the country in the form of oil products, natural gas and coal: this is the fastest growing source of GHG emissions in the country (68% increase in the period from 1990 to 2005).

The most recent ten-year Energy Plan (PDE), covering the period 2011-2020 (EPE, 2010), is already considered by the government as a sectoral mitigation plan, as it integrates a number of MAs: the increase of renewable power generation through large hydropower, wind, small hydro and bioenergy projects, and of biofuels (ethanol from sugarcane and biodiesel from vegetable oils), and energy efficiency improvements as projected in the PDE. The amount of avoided emissions in 2020 was estimated at 234 M t CO_2/y considering that all this additional renewable energy generation and energy saved would come from fossil fuels.

MME is responsible for approving and implementing the country´s energy policy. The technical inputs to MME are provided by the Energy Planning Agency (EPE), which formulates the studies leading to the PDE, detailing the energy programmes and projects to be implemented in the next ten years period. The listed power plants are then offered to the private sector in several rounds of call for tenders to build them, and a similar process is run for oil and gas fields.

The actual investment to implement these MAs will thus come from the private sector or state-owned enterprises such as Petrobras and Eletrobras. In the case of biofuels, and particularly of ethanol production from sugarcane in the Brazilian context, the profitability of these investments in the current oil price scenarios leads to the assumption that there will be no major problems in the flow of private funding to these MAs.

The cases of energy efficiency and of renewable power generation are different, because of the well known barriers that hamper their development. Economic incentives to promote renewables are already supplied from Brazilian federal budget (mainly through BNDES and Eletrobras), and also strengthened by some punctual initiatives at the state and municipal level. However, these MAs would be the most natural candidates as Brazilian NAMAs seeking financial support from the UNFCCC funding mechanisms. Other possibilities of international cooperation would be the multilateral financial bodies such as the World Bank and IDB, who may resume the role they had in the past for hydropower development, now under updated standard of environmental and social performance (such as those established by the World Commission on Dams, for example). Again, as PDE targets can be considered ambitious, this financial support could be valuable to improve the institutional capacity in the country to meet them.

Public players in this field, such as EPE, Eletrobras and BNDES, would be potential owners of the MAs, under the political coordination of MME.

EPE has the technical capacity to design the modalities of implementing these MAs and also to deal with the MRV-related issues, which are pretty straightforward to solve, being much less complex than for other GHG emission sources. The key issue will remain the inherent subjectivity associated to the choice of a counterfactual baseline to be compared with the actual energy policy followed by the country. There is no scientific approach capable of solving this issue that must be settled in the international negotiations table.

5.4 Others

For the bulk of other MAs, which are less significant in terms of total GHG avoided emissions, the sectoral mitigation plans are under development and are expected to be approved by the end of 2012 (initially scheduled for December 2011, and suffering from repeated delays). The sole exception is the already available Plan of Emission Reduction in the steel sector, including MAs targeted to increase steel manufacturing using charcoal from planted forests and improving the efficiency of charcoal kilns. This case combines issues from forestry and energy efficiency measures.

The Mining Sector Mitigation Plan is based on the Emissions Inventory sector carried out by the Brazilian Mining Institute (IBRAM) for 2008 and on the 2030 National Mining Plan. In the Mitigation Plan, sectoral emissions are estimated to be around 17,6 $MtCO_2e$ in 2020, with a potential reduction of 4%. The plan is focused on the mining activity itself, not considering external transportation and processing. The activities covered by the projections represent 80% of national production, include 14 mineral types and are mainly focused on the iron, copper, aluminium and coal production.

The Sectoral Mitigation Plans for the Industry and Transport sectors are the most important ones, due to the relevance of the GHG emissions, and will need to be consistent with the estimates done by the Energy Planning Agency in the 10-year and Long-term (2040) National Energy Plans. The Transport Plan details the investments required to expand ethanol penetration up to 75% in the light vehicle fleet, the investments on the infrastructure required to absorb the fast-growing light vehicle fleet in Brazil, and the modal shifts potential provided by investments in public transport.

The key challenges for MRVs of NAMAs remain within the Transport sector, particularly at the subnational level (cities and states). For the other mitigation actions (energy efficiency, renewable power generation, methane recovery and use from urban solid wastes), CDM methodologies are available and are straightforward to be applied at a programme level. However, the estimate of avoided GHG emissions by mitigation actions on intra-city passenger transportation, such as Bus Rapid Transportation Systems (BRTs), subway lines, light rail and improvement of the bus system (rerouting, integrated ticketing, exclusive bus lanes) is much more complex as it requires the proper accounting of modal shifts. This is data-intensive, requires primary data surveys, and is very site-specific. Moreover, cities do not always have the appropriate institutional setting (public transportation agencies keeping track of transport data with effective performance). The city of Rio de Janeiro alone is building five BRTs and extending subway lines, and the only estimates available for the avoided GHG emissions come from rough analogies with the Transmillenium project, using its CDM methodology (La Rovere et al, 2012). The same applies to São Paulo and Brasília. The sole exception is Belo Horizonte, where a good transportation municipal agency with support from IDB has recently provided a tailor-made estimate of the GHG emissions to be avoided through its Municipal Transportation Plan.

6. CONCLUSIONS

The successful achievement of the Country's voluntary GHG emission mitigation goals will depend upon the internal capacity to handle a number of issues that arise in the implementation of MAs, including (La Rovere, 2011):

- development of these mitigation actions (from the idea to concept note, business plan, and successful implementation);
- planning and establishing policy and regulatory context (both of individual mitigation actions and broader plans and strategies);
- setting up institutional capacity to take mitigation actions to implementation;
- creating technical capacity to design and domestically assure the monitoring, reporting and verification (MRV) of the mitigation actions;
- scheduling the means to financing these mitigation actions;
- outlining the ownership of the mitigation actions; and
- certifying the credibility of MAs MRV.

Moreover, accomplishments on overlaps and gaps regarding the institutional and regulatory framework should allow better governance conditions to the Country's climate change policy. Furthermore, as presented in the paper, the challenges related to the implementation of the Brazilian NAMAs are actually tough. The specificity of the Country's GHG emissions structure and dynamics, the uncertainties following-on the Forest Code amendment, the high level of renewables in the internal energy mix, the perspective of a huge intensification of oil & gas production from the pre-salt offshore fields, are major issues that should be taken in account in a mid to long-term perspective of climate change policy. These challenges will be increasingly important after 2020, when the focus of the mitigation actions will necessarily shift from the land use change to the energy system.

As land use change has been the most important source of GHG emissions in the country, successful efforts to reduce deforestation particularly in the Amazon and 'Cerrado' regions will be crucial to the achievement of Brazilian voluntary mitigation goals. The key target is the enforcement of laws and regulations that prevent illegal deforestation of conservation units and private properties. The recent record has shown the viability of a successful performance in this field, as deforestation in the Amazon was limited to 8,000 km2 in 2008, down from an average of 19.5 thousand km2 / year in the period 1996-2005. However, 2011 started with an increase in the deforestation in the Amazon region. This was partly due to the prospects of approval of a new version of the Forest Code, softening some constraints on the removal of forest cover in private properties but the final outcome of this amendment is still uncertain. Anyway, thanks to a strong effort towards the enforcement of laws and regulations, preliminary estimates for deforestation in the Amazon region in 2010/2011 were of 4,000 km2, the lowest historical record.

Therefore, Brazil seems in a good position to meet the voluntary mitigation goals pledged to the UNFCC up to 2020, as avoided deforestation will take up the bulk of the emissions reduction. In 2020, if governmental mitigation goals are met, GHG emissions from the energy system will take over and become the largest in the country.

After 2020, Brazil will in a situation more similar to other industrialized countries, faced with a new challenge of economic development with low GHG energy-related emissions. If no additional mitigation policies and measures are implemented, GHG emissions will start to increase again in the period 2020-2030, due to population and economic growth driving energy

demand, supply and GHG emissions up. In order to avoid this, the portfolio of additional mitigation actions would have to be substantially extended.

On the other hand, the challenge to curb down GHG emissions in Brazil is very different of the one faced by other emerging economies such as China, India and South Africa. These countries heavily rely on coal to supply its energy needs and thus have much higher emissions intensities per GDP and mitigation potentials than Brazil (see Jiang et al, 2009; MoEF, 2010; SBT, 2007). Yet, the ambition of its voluntary goals is much lower than in the Brazilian case due to the time required to develop and deploy low carbon energy technologies.

However, Brazil is in a privileged position to take a lead in low-carbon economic and social development due to its huge endowment of renewable energy resources. On the demand side, it seems imperative to limit oil consumption in the transport sector, heavily dominated by road transport of cargo and cars in cities. Modal shifts towards railways and waterways, as well as the long due development of mass transportation infrastructure in cities, will be required. Unlike the mitigation actions in the land use change sector, where most of the funding will come from the national budgets, due to sovereignty concerns, the huge financial resources needed to develop low-carbon transport infrastructure could benefit from soft loans channelled to the country through NAMAs (La Rovere, 2011).

7. REFERENCES

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8. Endnotes

i The Mitigation Action Plans and Scenarios (MAPS) programme is collaboration between a number of developing countries, promoting best practice in mitigation action planning or scenarios development. The MAPS programme seeks to achieve this by support to in-country processes informed by research. It seeks to share and deepen the leanings through collaboration between Southern experts supporting government programmes.

ii Source: Brazil's Second National Communication (2010)

iii Source: Brazil´s National Climate Change Policy Law (2009)

iv Source: Brazil's Federal Decree no 7390 (2010)

v This subsection is extracted from La Rovere and Poppe (2012).